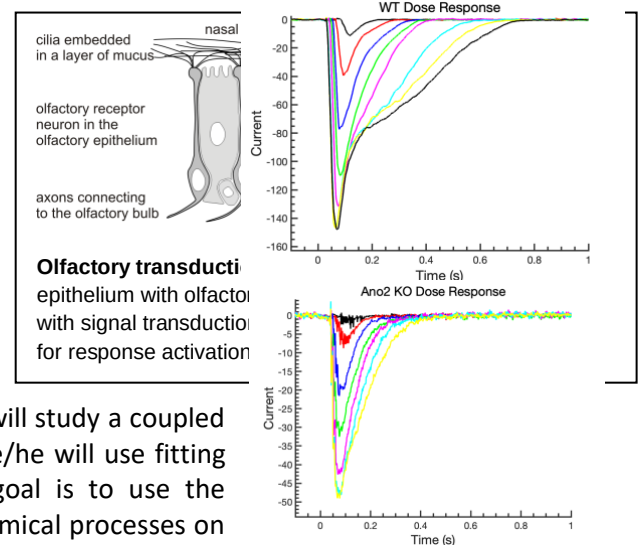




## Analysis and modelling of electrophysiological recordings from olfactory receptor neurons of genetically modified mice

**Background:** Olfactory receptor neurons (ORNs) are the fundamental neurons underlying smelling. They are located in the olfactory epithelium in the nose and have around 15 tiny cilia (~30  $\mu\text{m}$  long, ~200 nm diameter) where odorant molecules bind to receptors located in the ciliary membrane. This initiates a biochemical signal transduction cascade that opens ion channels and generates an electrical current. A key challenge is to model and understand the current response as a function of the biophysical processes.

**Aims:** The student will analyze recent electrophysiological data from the lab of our collaborator King-Wai Yau from the Johns-Hopkins University in the USA. The data shows electrical responses of ORNs extracted from genetically modified mice to brief stimulations with various odorant intensities. Because the genetic modifications alter different components of the signal transduction pathway, this will allow to reconstruct the contributions of the various processes based on the differences in the recordings. Based on previous work in the lab, the student will modify and extend a molecular signal transduction model in order to reproduce the electrophysiological recordings. The student will study a coupled system of ODEs with simulations and analytic tools, and she/he will use fitting procedures to match the model to the data. The final goal is to use the calibrated model to dissect the impact of the various biochemical processes on the neuronal response.



**Candidate:** The candidate should be highly motivated and interested in neuroscience. He/she should have a background in physics, applied mathematics or computer science. She/he should also be familiar with computer simulations using C/Python or Matlab. The candidate should be passionate by her/his research. Students are encouraged to write a publication at the end of the period, and we encourage motivated student to continue on a PhD thesis.

### Literature:

- Li et al, *Low signaling efficiency from receptor to effector in olfactory transduction: A quantified ligand-triggered GPCR pathway*, PNAS (2022)
- Reisert and Reingruber, *Ca<sup>2+</sup>-activated Cl-current ensures robust and reliable signal amplification in vertebrate olfactory receptor neurons*, PNAS (2019)